MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

EEE 7286 – ENERGY MANAGEMENT IN INDUSTRY

12 JULY 2023
9:00 AM – 12:00 PM
(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages including cover page with 4 Questions only.
2. Answer ALL questions. The distributions of the marks for each question are as stated.
3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) Distinguish between renewable and non-renewable energy. Provide TWO examples for each of the type of energy resource.

[8 marks]

(b) Explain the term "energy trilemma" which has been gaining traction among the energy community globally over the past decade.

[4 marks]

(c) Energy Manager needs to have a clear vision of what energy management can do for the company. State FIVE roles of an Energy Manager.

[5 marks]

(d) In your opinion, which category of individual(s) in an organisation plays the most crucial part in ensuring the success of an Energy Management Programme (EMP)? Explain the reason of your selection and how you can engage them to be involved effectively in an EMP.

[8 marks]

Continued...

Question 2

(a) As a utility company, the electricity tariff has to be set in such a way to preserve sustainability of operation. Hence, utility costs have to be appropriately managed. State FIVE costs that a utility company have to bear.

[5 marks]

(b) The following electricity tariff is applicable for an industrial plant in a particular country which is heavily reliant on fossil fuels for power generation.

Table Q2(b): Tariff for an industrial plant

Tariff Category		Rate
Low Voltage	First 200 kWh per month	50 cents/kWh
	201 kWh – 400 kWh per month	44.10 cents/kWh
	401 kWh onward per month	38.20 cents/kWh

(i) Comment on the type of tariff structure in Table Q2(b). [3 marks]

(ii) Discuss the pros and cons of such tariff structure.

[4 marks]

(iii) As an Energy Manager, do you think that such tariff structure will be helpful for your job?

[4 marks]

(c) A factory is operating 12 hours a day for the whole year of 2020. The average load was 300 kW and maximum demand of 350 kW at 0.75 power factor.

(i) Compute the amount of cost of power consumption based on the following tariff:
$0.10 per kWh
$7.50 per month per kVA of maximum demand

[4 marks]

(ii) The factory owner then consulted you on what could be done to reduce the electricity bills. How would you respond to her as an electrical engineer? Convince her to adopt your proposal with the relevant calculations.

[5 marks]

Continued...

Question 3

(a) Table Q3(a) outlines the relevant conditions of 10 blowers and fans which are kept running 24 hours daily in a warehouse. As an Energy Manager, recommend energy saving measures involving the 10 blowers' system. Clearly explain your recommendations.

Table Q3(a) Information of the blowers system

Blower	Years of operation	Number of poles	Starter	Damper control	Speed (RPM)	Power factor	Loading factor (%)
1	10	4	Autotrans	Fully	1475	0.80	45.1
2	25	4	Soft starter	Level 2	1488	0.77	66.2
3	15	4	Soft starter	Level 3	1490	0.61	55.5
4	30	4	Autotrans	Level 3	1470	0.66	72.1
5	30	4	Autotrans	Fully	1478	0.80	70.8
6	22	4	Autotrans	Fully	1480	0.70	65.4
7	25	4	Soft starter	Level 3	1477	0.75	51.1
8	18	4	Soft starter	Level 2	1484	0.85	67.8
9	30	4	Autotrans	Fully	1480	0.80	85.6
10	30	4	Autotrans	Fully	1480	0.77	69.1

[5 marks]

(b) Propose TWO ways to improve efficiency of motor for the following applications:

(i) A pump whereby the flow is controlled using throttling valves [4 marks]

(ii) Air compressors [4 marks]

(c) Indoor air quality is an important aspect as it directly implicates the health and comfort of building occupants. However, striking a balance between excelling in energy management and maintaining excellent indoor air quality could be challenging.

(i) Discuss the primary causes of poor indoor air quality problems. [4 marks]

(ii) Recommend THREE strategies which can be employed to mitigate poor indoor air quality problems. [3 marks]

(d) Demand side management (DSM) is defined as the planning, implementation and monitoring of utility activities designed to influence customer use of electricity in ways that will produce desired changes in the utility's load shape. State the FIVE steps in the correct sequence which should be undertaken while planning the framework of DSM. [5 marks]

Continued...

Question 4

(a) The power generation entities can generally be divided into TWO categories.

(i) Identify the TWO categories. [2 marks]

(ii) Describe the TWO categories mentioned in (i). [4 marks]

(iii) As an Energy Manager, choose ONE of the categories that you will most likely recommend to your client. Assess and provide TWO reasons to support your choice.

[4 marks]

(b) An industry has its own dedicated Combined Cycle Gas Turbine power plant which operates in parallel with the grid. In total, the industry requires 100 MW at 0.85 lagging power factor. At present, the real and reactive powers generated by the power plant is 90 MW and 55 MVAR respectively. Total real and reactive power losses in the distribution system are 3 MW and 1.5 MVAR. Grid frequency is 50 Hz. A capacitor bank is connected at the 11 kV bus of the power plant to improve the power factor of the power imported from the grid to 0.95.

(i) Calculate the real and reactive powers to be imported from the grid.

[5 marks]

(ii) Work out the size of the capacitor bank connected for the power factor adjustment.

[7 marks]

(iii) Explain THREE advantages of a Combined Cycle Gas Turbine power plant.

[3 marks]

End of Paper